Risk Factors for Caries in Children from South-Western Nigeria

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Objective: *The objective of this study was to understand the relationship between relevant socio-economic, biological and behavioral indicators and dental caries experience of Nigerian children.*
Method: *A cross sectional study design was utilized. The study population consisted of children who visited two Child Dental Health Clinics in South Western Nigeria. Information collected include demographic data, feeding practices, dietary habit, use of medications and daily frequency of tooth brushing. The number of decayed, filled and missing teeth (dmft/DMFT) was noted for children with caries. A stepwise logistic regression analysis was carried to select the best predictor for the presence of caries and for high caries levels (a dmft/DMFT greater than 3).*
Results: *The only predictor for caries was age with the possibility of having caries being 0.89 (11% reduced odds) for every year increase in age (95% CI 0.82 to 0.97) p=0.008. However, the predictor for a high caries level was age and gender; the odds of having a dmft/DMFT equal to or higher than 3 was 0.80 (20% reduced odds) for every year increase in age (95% CI 0.72 to 0.88) p<0.001 and 0.57 (43% reduced odds) for every female child (95% CI 0.33 to 0.98) p=0.04 compared to a male child.*
Conclusion: *Children from this study population who consumed sugar once a day are at risk of developing caries. Also, male children whose daily consumption of sugar was equal to or greater than three times daily, were at risk for having a dmft/DMFT higher than 3.*
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INTRODUCTION

The etiology of caries is multifactorial and complex. The understanding of its biopathology has changed over the last 20 years. It is now seen as a continuum of a disease process produced by a microsystem at various stages resulting in an oscillation between hard tissue demineralization and remineralization.[1-3]

Over the years, a number of studies have tried to expand the basic model of caries to include various social, demographic and behavioral factors. These factors include various socioeconomic, biological, psychosocial and behavioral indicators.[5,6] These varied cross sectional models demonstrate the complex interaction between these indicators and the presence of caries.[7-9] However, the models have an inconsistent predictive power.[9]

These studies reflect the importance of other factors other than the presence *of Mutans Steptococcus* alone in the etiology of dental caries and the role of applying the life course approach to oral health. There is a growing consensus that social variations in health can be studied more productively in terms of a life course approach[6] and that there may be a relationship between early life experience and adult disease occurrence.[10]

While there is a growing body of information on the interaction between various identified factors in the etiology of caries around the world, very little is known about how these factors interrelate to cause this chronic disease process in developing economies like Nigeria. Current global focus is on the management of caries like other chronic diseases,[6,11] yet, epidemiological studies show that the profile of chronic diseases vary among geographic regions. The objective of this study, therefore, is to show the relationship between some relevant socio-economic, biological and behavioral indicators and the dental caries experience of a hospital based population of children from south-western Nigeria.

METHOD

A cross sectional study design was utilized. The sample size was determined using the a sample size determination table.[12] A previous study suggests that the prevalence of caries in Nigeria children is about 10.5%.[13] The sample size needed to predict a 12% prevalence level for rampant caries at α (two sided) =0.05 and, =0.20 is 112.

The study population consisted of children who visited the Child Dental Health Clinic of the Obafemi Awolowo

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University Teaching Hospitals Complex, Ile-Ife, Nigeria and the Massey Children Specialty Hospital, Lagos, Nigeria. These are specialty clinics located in south-western Nigeria, one of the six geopolitical zones in Nigeria. The data collection continued until the estimated sample size was reached. All children who visited the dental clinic for any form of treatment were enlisted in the study. Verbal consent was received from the parent of the child for inclusion in the study. Any child accompanied by the guardian or whom parental consent could not be received for study participation was excluded from the study.

Information collected included the age of the child, the gender, birth rank (biological indicators) and the socioeconomic status (socioeconomic indicator). The age of the child was the age as at last birthday. For analysis purposes, the age was divided into three groups: Group 1: age 1-5 years, Group 2: 6-10 years and Group 3: 11-16 years. The socioeconomic status (SES) was obtained through an index of the mother's level of education and the father's occupation. This index allocated each child in a sociological class ranging from I to V with the social class V being at the bottom.[14] For statistical analysis, the SES was classified as high (SES I and II), middle (SES III) and low (SES IV and V) socio-economic classes.

The mother was questioned about feeding practices (biological indicators). These included the use of a pacifier, breast feeding and bottle feeding, the duration of breast and bottle feeding, and form of breast feeding at night. The form of breast feeding at night was defined as either breast feeding on demand or leaving the nipple in the mouth of the child overnight.

Mothers were also quizzed about dietary habit, long-term use of medications and daily frequency of tooth brushing (behavioral indicators). The mothers were asked to assess the frequency of the daily intake of a sugary diet. A sugary diet was defined as any solid or liquid diet than contained refined carbohydrates. Mothers were also asked if the child had to use liquid medications continuously for more than six weeks and what the daily frequency for tooth brushing was.

The assessed factors were grouped as socio-economic (socioeconomic status), biological (birth order, gender, age and feeding practice) and behavioral (dietary habit, frequency of tooth brushing) indicators.

The number of decayed, filled and missing teeth (dmft/DMFT) was noted for children with caries. The dmft/DMFT was determined based on the WHO Oral Health Survey methods.[15] The examination for dental caries was conducted with a plane mirror using a light source from the overhead lamp of the dental chair. The teeth were not dried before examination but gross debris was cleared with gauze when necessary. Examination for dental caries included all surfaces. Radiographs were taken to confirm the diagnosis of caries in all cases. For ease of statistical analysis, the dmft/DMFT was grouped into seven groups namely 0, 1-3, 4-6, 7-9, 10-12, 13-15 and greater than 15. Children with dmft/DMFT below the mean DMFT were classified as having low level of caries and those with dmft/DMFT higher than or equal to the mean dmft/DMFT for the group was classified as having high levels of caries.

The diagnosis of caries or no caries was made for each child. A diagnosis of caries was made when there are carious lesions affecting the tooth inclusive of the maxillary anterior tooth/teeth. In the absence of any carious lesion, a diagnosis of no caries was made.

Statistical analysis was done using the Intercooled STATA (release 9) for windows. Simple proportions were computed. A general linear model (Poisson) was used to establish the association between each of the four groups of caries indicators and the caries experience of the child. The dmft/DMFT is used as the measure of outcome (caries) at this level. For each group, a stepwise logistic regression analysis was carried to select the best predictor at this level for the presence of caries and for high caries levels. The level of statistical significance set up in the stepwise regression was 0.05 to enter the model. The selected variable at each level are included into the final model. Logistic regression was used to determine risk factors for caries having forced significantly associated factors to fit into the model. Statistical significance was inferred at $p = or < 0.05$.

RESULTS

A total of 269 children were included in this study; 131 (48.7%) were male and 138 (52.3%) female. Their ages ranged from 1 to 16 years and their birth rank ranged from been an only child to being the 8th child. One hundred and twenty children (44.8%) had caries. Their dmft/DMFT ranged from 1 to 17. The mean dmft/DMFT was 3.0. The profile of the study participants, including information on the distribution by socio-economic status, frequency of daily sugar consumption and the dmft/DMFT, are reported in Tables 1 to 4.

Two children were not breast-fed leaving 267 breast-fed children. The duration of breast feeding ranged from 1 to 48 months with a median of 15 months (IQR 12 to 18 months). Majority of the children (61%) did not use the feeding bottle. For the remaining 39% bottle-fed children, the duration ranged from 1 to 30 months with a median of 12 months. Most of the breastfeeding mothers breastfed the child in the night only on demand (62.5%). The frequency of daily intake of sugar ranged from no sugar intake (7.34%) to more than three times daily (20.85%). Most of the children took sugar only once daily (37.45%). Table 2 shows the frequency distribution of these variables.

The first step of data analysis was to select the best predictors of caries from each indicator group. These predictors were then regressed to identify the best predictors for caries and high caries levels.

There was no association between the dmft/DMFT and the socioeconomic status ($p=0.79$), a socio-economic indicator.

There was an association between the dmft/DMFT and some biological indicators: gender ($p<0.001$), age ($p<0.001$), birth rank ($p<0.001$), duration of breast feeding ($p<0.001$), form of breast feeding ($p=0.032$), duration of

Table 1. Profile of study participants

s. no	Variables	Frequency
	Age	
1	1-5 years	106 (39.41%)
2	6-10 years	130 (48.33%)
3	11 – 16 years	33 (12.27%)
	Total	269 (100.00%)
	Socioeconomic status	
1	Very high	8 (3.00%)
2	High	50 (18.73%)
3	Middle	80 (29.96%)
4	Low	109 (40.82%)
5	Very low	20 (7.49%)
	Total	**267 (100.00%)**
	Birth rank	
1	1	100 (38.17%)
2	2	71 (27.10%)
3	3	39 (14.89%)
4	4	22 (8.40%)
5	5	18 (6.87%)
6	6	8 (3.05%)
7	7	2 (0.76%)
8	8	2 (0.76%)
	Total	262 (100.00%)
	Form of breast feeding	
1	No breast feeding	2 (0.77%)
2	On demand	163 (62.45%)
3	Leaves the nipple in the mouth overnight	96 (36.78%)
	Total	**261 (100.0%)**
	Frequency of daily sugar consumption	
1	Nil	19 (7.34%)
2	Once	97 (37.45%)
3	Twice	55 (21.24%)
4	Thrice	34 (13.13%)
5	More than three times	54 (20.85%)
	Total	**259 (100.0%)**
	Use of pacifiers	
1.	No	261 (98.49%)
2.	Yes	4 (1.51%)
	Total	**265 (100%)**
	Prolonged use of medication	
1. No		207 (78.71%)
2. Yes		56 (21.29%)
	Total	**263 (100%)**

Table 2. Age distribution and DMFT

	Age group			
DMFT	**1-5 years**	**6-10 years**	**11 – 16 years**	**Total**
0	29	45	18	92
1-3	24	52	11	87
4-6	18	19	2	39
7-9	18	7	1	26
10-12	11	5	0	15
13-15	4	1	0	6
13-17	2	1	0	3
Total	**106**	**130**	**32**	**268**

Average dmft = 3.2 (95% CI 2.72-3.68)

Table 3. DMFT and socio-economic status

	Socioeconomic status					
DMFT	**Very high**	**High**	**Middle**	**Low**	**Very low**	**Total**
0	3	23	27	32	7	92
1-3	2	13	22	42	8	87
4-6	2	5	17	14	1	39
7-9	1	5	6	11	2	25
10-12	0	2	5	8	1	16
13-15	0	1	3	1	0	5
16-17	0	1	0	1	1	3
Total	**8**	**50**	**80**	**109**	**20**	**267**

Table 4. DMFT and frequency of daily sugary consumption

	Frequency of daily consumption of sugary diet					
DMFT	**Nil**	**Once a day**	**Twice a day**	**Thrice a day**	**> than thrice a day**	**Total**
0	14	44	16	7	11	92
1-3	3	24	22	16	17	82
4-6	0	20	6	5	6	37
7-9	1	5	7	3	9	25
10-12	1	2	3	2	7	15
13 – 15	0	0	1	1	3	5
> 17	0	2	0	0	1	3
Total	**19**	**97**	**55**	**34**	**54**	**259**

bottle feeding (p<0.001). There was no association between dmft/DMFT and use of pacifiers (p=0.17).

On stepwise logistic regression, the only predictor for caries was age with the odds of having caries been 0.89 (11% reduced odds) for every year increase in age (95% CI 0.82 to 0.97) p=0.008. However, the predictors for high caries level were the age and the gender; the odds of having a dmft/DMFT equal to or higher than 3 was 0.80 (20% reduced odds) for every year increase in age (95% CI 0.72 to 0.88) p<0.001 and 0.57 (43% reduced odds) for every female child (95% CI 0.33 to 0.98) p=0.04 compared to a male child.

There was an association between the dmft/DMFT and frequency of daily consumption of sugar (a behavioural indicator) with a p-value of <0.001. There was no association between the dmft/DMFT and the other behavioral indicators namely daily frequency of tooth brushing (p=0.23) and the long use of liquid medication (p=0.17).

The next step was to enter the variables selected from the indicator groups together in a stepwise logistic regression and determine the predictors for caries and high levels of caries in this study group. The result showed that the risk for having caries increases as the frequency of daily consumption of sugar increases (Table 5). The odds for caries was 0.89 (95% CI 0.82 to 0.97) p=0.01 for every year increase in age and increases by almost 2 folds (odds of 1.61) for every increase in the frequency of daily consumption of sugar (95% CI 1.27 to 2.10) p<0.001. Also, a male child whose daily consumption of sugar was equal to or greater than three times daily has higher risks for high caries levels (Table 5).

Table 5. Risk factors for caries and high caries levels

A. Caries

Age

	Coefficient	95% Confidence interval	P value
> 1 year (referent)	1.00	—	0.05
2-5 years	0.28	-0.10 to 0.87	0.15
6-9 years	0.20	-0.19 to 0.59	0.31
10-13 years	0.11	-0.29 to 0.51	0.60
> 13 years	-0.06	-0.51 to 0.38	0.79

Daily frequency of sugar consumption

	Coefficient	95% Confidence interval	P value
Once a day	0.33	0.90 to 0.46	0.043
Twice a day	0.37	0.33 to 0.61	0.002
Thrice a day	0.46	0.20 to 0.72	0.001
More than 3ce a day	0.45	0.22 to 0.70	0.000

B. High caries level

Age

	Coefficient	95% Confidence interval	P value
> 1 year (referent)	1.00	—	0.000
2-5 years	0.28	-0.09 to 0.66	0.14
6-9 years	0.14	-0.24 to 0.52	0.46
10-13 years	-0.23	-0.62 to 0.17	0.26
> 13 years	-0.14	-0.57 to 0.30	0.53

Daily frequency of sugar consumption

	Coefficient	95% Confidence interval	P value
nil per day (referent)	1.00	—	0.005
Once a day	0.15	-0.07 to 0.38	0.19
Twice a day	0.20	-0.04 to 0.44	0.11
Thrice a day	0.31	0.05 to 0.57	0.019
More than 3ce a day	0.39	0.15 to 0.64	0.002

Gender

	Coefficient	95% Confidence interval	P value
Female	-0.13	-0.24 to -0.02	0.02

DISCUSSION

This study demonstrates that interplay between biological factors (age and gender) and a behavioral variable (daily frequency of sugar consumption) increases the risk for caries risk in Nigerian children.

The frequency of tooth brushing, use of pacifiers and the birth rank of the child does not play a significant role in the etiology of caries in this study population, unlike what has been reported in other studies. Very few children use pacifiers in Nigeria. This study found no association between use of pacifier and the risk for caries.

The associated risk between the use of a pacifier and caries is due to prolonged contact of the teeth with cariogenic agents, such as pacifiers dipped in sugar as well as feeding bottles. These objects, just like other biological variables in this study, are therefore facilitators of cariogenic processes rather than being cariogenic agents in themselves. These biological variables are however, not associated with caries risk in this study population.

While past studies have demonstrated an age related effect on the incidence of caries,[16-19] this study notes that the interplay between age and frequency of daily sugar consumption affects the risk for caries. Age, interplaying with gender and the frequency of daily consumption of sugar, is equally important in the risk for high caries level. While age and gender are biological factors that cannot be modulated, the frequency of sugar consumption can be modulated in various ways to address the caries risk in this population.

Past studies have shown a decline in the risk of occlusal dental caries in industrialized countries[20-23] while there is an increase in the sub-Saharan Africa.[24, 25] Studies in Nigeria note that while the caries prevalence is lower than that of other developed countries,[26] continued presence of risk factors could increase this prevalence level in the near future. Identifying the risk factor for caries and then addressing them remains vital.

One critical approach is to adopt the life course approach to the management of chronic diseases, such as caries. Sheiham and Watts[11] noted that the frequency of sugar intake is an identified risk factor for chronic diseases such as diabetes and caries. Modulation of this risk factor would not only address the caries risk of these children but also the development of other chronic diseases that may be outcomes of lifetime behavior. Nicolau *et al* [6] point out that a majority of people do not change their life course and behavior without definitive interventions. Effecting changes in oral health risk behavior would require identifying the risk factors for diseases and effecting habit change through the common risk factor approach implemented through a comprehensive health promotion strategy as recommended by the Ottawa Charter.[27]

The outcome of this study however has limited extrapolation to the general Nigerian public because the sample was taken from a hospital based population. At best, the report of this study serves as a possible pointer to what may be observed in the general population. A community based survey would give a better perspective of these issues for other Nigerian children.

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